SCIENCE

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JOHN ERICSSON.

CAPT. JOHN ERICSSON died in New York at twenty-one minutes before one, Friday morning, March 8. He was cared for in his last moments by his attending physician, Dr. Joshua C. Boullee; his superintending engineer, V. F. Lassoe; and his secretary, S. W. Taylor. His last words were, "Give me rest," which followed an inquiry if he must die. Up to the last he retained his wonderful mental energy, his mind being concentrated on the work he had in hand.

The world has lost in this death one of its hardest workers, and one who has done his full share in advancing human welfare. So earnestly was he a worker, that he had not for years allowed any one to see him except on matters pertaining to his experiments. He would receive a tinsmith bringing a can for his laboratory; but he declined to meet Gen. McClellan, who expressed a wish to call on the great engineer. Even his associates could not induce him to break, in any case, this rule that he had made for his life.

JOHN ERICSSON.

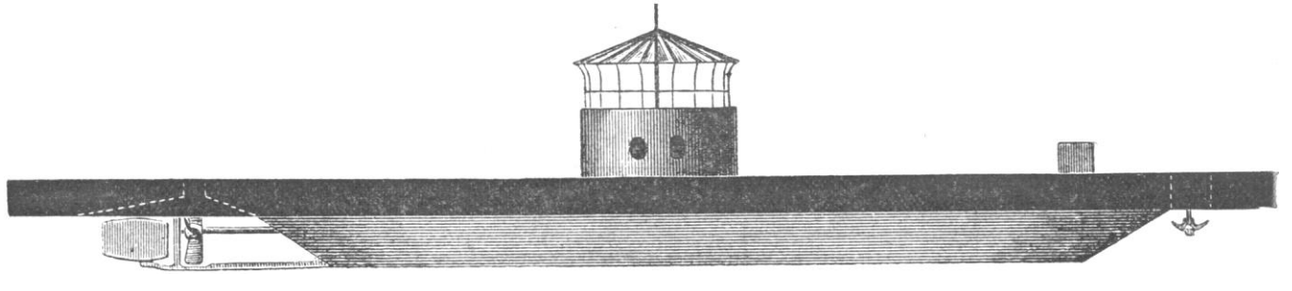
His whole life was given to his work, and his only desire in living was to complete a task that he had set himself. For this reason he retained his residence in Beach Street so long after the locality had been encroached upon by business structures and tenement-houses. This residence originally faced on St. John's Park, but is now shadowed by the gloomy walls of the freight-depot of the New York Central Railroad. Its form, however, is the same as when Beach Street was one of the most aristocratic neighborhoods in the city.

His workshop was in the basement of his residence, and the whole building bore evidence of his vocation. The only ornaments in his parlor were models of his inventions, and a set of engraved resolutions passed by the New York Legislature in acknowledgment of his public services.

The first symptoms of the final illness appeared about three weeks ago, and, on account of his age, little hope was entertained from the first. But even on his death-bed his work was the one thing constantly before him; and among the last things he did was to leave special instructions to Mr. Lassoe, his assistant, for the completion of the work he was engaged in, the development of his sun-motor. He also left to Mr. Lassoe certain plans which he had originated for American coast defences.

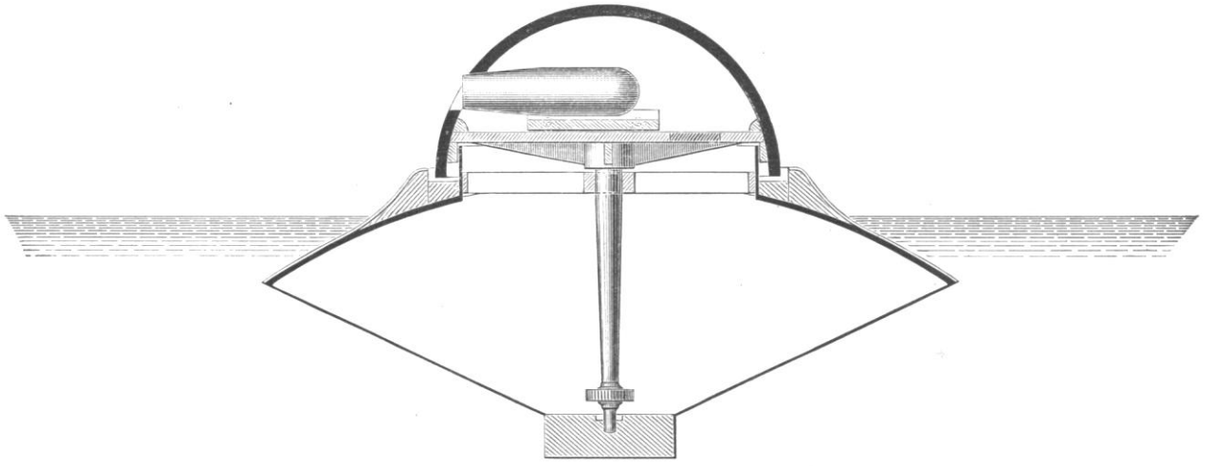
Capt. Ericsson was born July 31, 1803, in the province of Wermland, Sweden. His father, Olof Ericsson, was proprietor of mines; his mother, Sophie, the daughter of an iron-master. He was married in England about fifty years ago, but his wife has been dead a quarter of a century; and he leaves no children.

His special talent showed itself at the age of ten, when he constructed a miniature saw-mill and a pumping-machine that attracted notice. At twelve he was made a cadet of mechanical en-



THE "MONITOR" OF 1862.

gineers; the following year, a leveller on the canal. At seventeen, Ericsson entered the army as an ensign, and rapidly reached a lieutenancy in consequence of his beautiful military maps, which had attracted the special attention of King Charles John (Bernadotte).

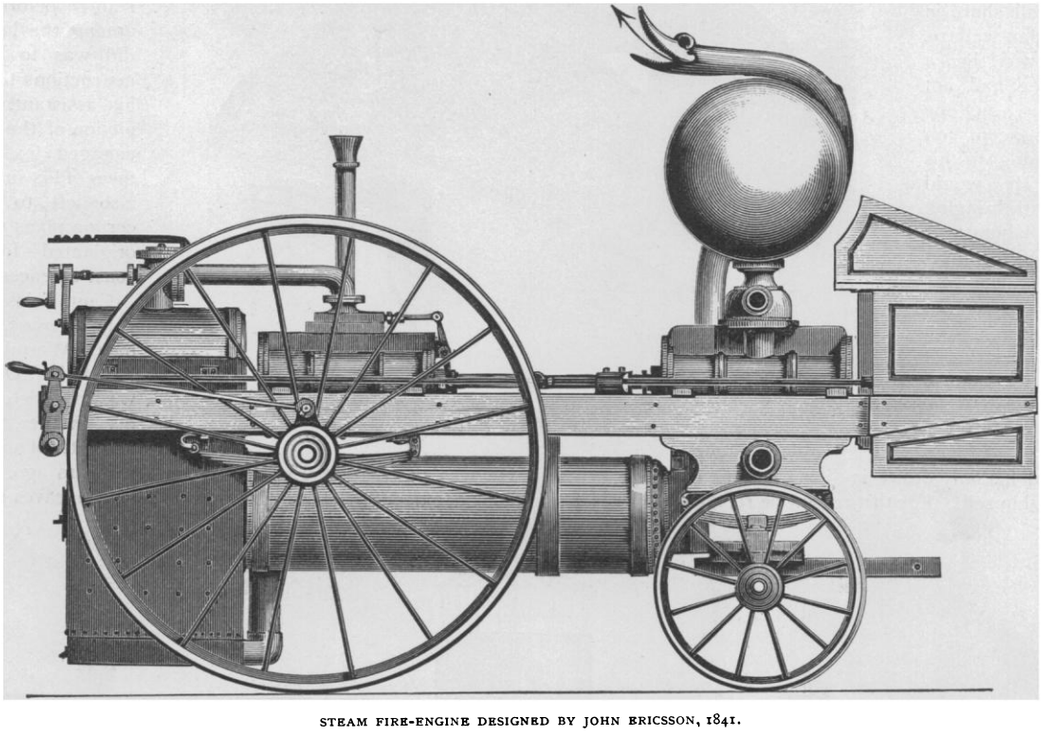


IRONCLAD CUPOLA VESSEL DESIGNED BY JOHN ERICSSON, 1854.

When about twenty-two years old, Lieut. Ericsson constructed a flame-engine of 10 horse-power, and journeyed to London in 1826, on leave, to introduce it. Once there, he resigned his commission. The resignation was accepted, but first he was promoted to a captaincy. He has never returned to his native country, but from it has received many honors and decorations; while in 1867 a great granite monument, quarried by the unpaid labor of the miners, some of whom had worked for his father, was set up with gala festivities in front of his mansion, inscribed, "John Ericsson was born here in 1803." It is under this stone that his last resting-place may be, though at this writing nothing definite can be said.

During the next few years, Ericsson produced about forty machines. They included a file-cutting device, an instrument for taking soundings (still in use), a hydrostatic weighing-machine, an apparatus for making salt from brine, a pumping-engine, a rotary steam-engine, and a famous system of artificial draught for steam-boilers, dispensing with huge smoke-stacks, and economizing fuel. To the steamship "Victory," in 1828, he applied the principle of condensing steam and returning the water to the boiler; and four years later he gave to the "Corsair" the centrifugal fan-blowers now generally used in American steam-vessels. In 1830 he introduced in the locomotives "King William" and "Adelaide" the link motion for reversing steam-engines. In 1834 he superheated steam in an engine on the Regent's Canal Basin.

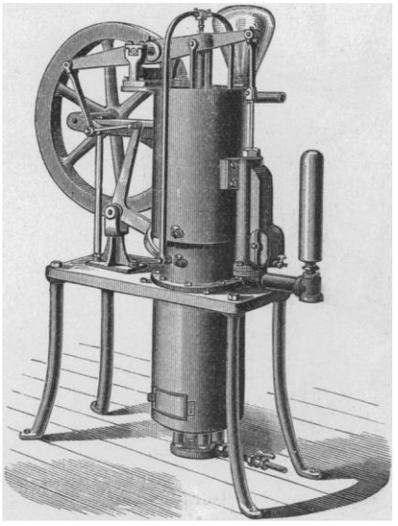
In 1829 the Liverpool and Manchester Railway had offered a prize for competing locomotives. Ericsson planned and hurried to completion an engine, the "Novelty," in seven weeks. The London *Times* of Oct. 8, 1829, said that in speed it "far excelled" all competitors. It shot along the line at the amazing rate of thirty miles an hour; but Stephenson's "Rocket" proved superior in point of traction. Ericsson in 1829, nearly threescore years ago, constructed a steam fire-engine, employed in putting out a fire in the Argyle Rooms, which was objected to as throwing too much water.



STEAM FIRE-ENGINE DESIGNED BY JOHN ERICSSON, 1841.

So much for his progress in England. For Ericsson's removal to

America in 1839, we have to thank the English Admiralty. In 1837 he built a tug, having two propellers of 5¼ feet diameter, invited the British Admiralty to inspect it, and towed their barge at a rapid rate; but their lordships solemnly concluded, that, as the motive power was in the stern, the novel craft would not steer. Thus it was in America, in 1841, that he began to build the "Princeton," the first naval vessel that ever carried her machinery under the water-line, out of the reach of hostile shot.



ERICSSON'S CALORIC ENGINE FOR DOMESTIC PURPOSES.

In 1839 Congress had authorized the construction of three warships. In 1840 the secretary of the navy, in obedience to that law, ordered two to be constructed. The question of whether steam could or could not be successfully applied to war-vessels had not then been solved, the fear of danger from ignition by fire prevailing in the minds of all naval men. One of the officers of our navy, Capt. William Hunter, submitted a plan by which wheels were to be inserted in the bilge of the vessel on each side, — submerged wheels. Ericsson had demonstrated his plan to be feasible, in his experiments in England. The secretary of the navy, in authorizing the construction of these two vessels, directed that one was to be built on Ericsson's plan, and one on Hunter's plan. Hunter's plan proved a total failure: Ericsson's plan laid the foundation of the present steam marine. The "Princeton" was the first war-propeller ever built on the face of the earth, and in her he brought forward not only his propeller, but a great many appliances appurtenant to steam navigation which have since been used in our service.

The honor of having built the first practical screw-steamer was thus Ericsson's, — an invention which was matched by that of the "Monitor," fifteen or twenty years later.

Such a device was offered by Ericsson in 1854 to Napoleon III. The story of what happened in 1862 is too well known to need repetition here. By extraordinary energy and executive skill, the "Monitor" was launched, with steam-machinery complete, a hundred days from the laying of the keel plate, and arrived in Hampton Roads just in time to defeat, March 9, 1862, the Confederate ironclad "Merrimac," which had destroyed the "Cumberland" and "Congress," and was about to sink or disperse the rest of the government's wooden fleet. Naval warfare was revolutionized.

The Mechanics' Institute of New York offered its great gold medal in January, 1840, as a prize for the best plan of a steam fire-engine. Ericsson, having several years previously designed such machines in England, among which may be mentioned the steam fire-engine employed during the memorable fire at the Argyle Rooms in London in 1830 (the first time fire had ever been extinguished by the mechanical power called forth by fire), had no difficulty in producing plans complying with the conditions of the Mechanics' Institute in a manner warranting the award of the prize offered.

His caloric engine was produced in 1833. In 1853, a voyage of the caloric ship "Ericsson," a vessel of 2,000 tons, 260 feet long, from New York to Washington and back, showed, that, though economical in fuel, the new heated-air motor could not produce speed enough at sea for commercial purposes, nor compete on any large scale with steam. Still, it has been applied successfully in thousands of engines to minor useful purposes.

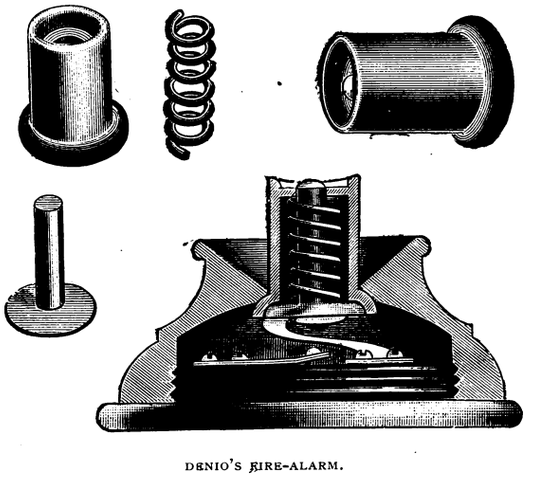
Favored by the possession of a robust constitution and ample means, Ericsson devoted many of his last years exclusively to the investigation of solar heat, and to the determination of the mechanical energy which the sun has in store for mankind when the coal-fields become exhausted. A sun-motor (illustrated in *Nature*, xxix. p. 217) erected in 1883 was found to develop under ordinary sunshine a steady and reliable power. Although he was eighty-six years old, and by no means well since the beginning of the year, Capt. Ericsson continued to labor at this motor until within two weeks of his death; and, as he saw his end approaching, he expressed regret only because he could not live to give this invention to the world in completed form. It occupied his thoughts up to his last hour. While he could hardly speak above a whisper, he drew his chief engineer's face close to his own, gave him final instructions for continuing the work on the machine, and exacted a promise that the work should go on.

No visitor was allowed to enter his workshop. Even his most intimate friends have never gained entrance there. Nor has any servant been in the room where the captain spent more than twelve hours daily for thirty years.

Here in his workshop, as it were, Ericsson lived, and here he died, a recognized leader among those who have added to human welfare, and honoring by his name the rolls of more than a score of associations of learned men.

THE DENIO FIRE-ALARM.

WE illustrate herewith a simple automatic fire-alarm combined with an ordinary electric push-button, which is being manufactured by the Denio Fire Alarm Company of Rochester, N.Y. The construction and operation of the device will be readily understood from the following description. In a thimble with an internal flange at one end, an external hollowed flange at the other, is placed



DENIO'S FIRE-ALARM.

a spring slightly longer than the thimble. This spring, one end of which bears against the internal flange, is compressed, and held in place by a pin which passes through it, the head of the pin fitting snugly in the recess made in the external flange of the thimble. The pin is sufficiently long to project entirely through the orifice in the internal flange end of the thimble. When the parts have been put together, the pin is secured in place by soldering to the flange, the solder used for this purpose being an alloy which will fuse at a low temperature, 150° to 160° F.

By removing the porcelain knob from any of the ordinary push-buttons now in use, and substituting this thimble, the button is

converted into an automatic fire-alarm, without in any way interfering with its use as a call. Pressure upon the thimble causes electric contact between the springs in the base of the button-fixture, in the usual manner, completing the circuit and ringing the bell.

As a fire-alarm, it operates as follows: When the heat of any room in which this attachment has been placed reaches a predetermined temperature, the alloy melts, and releases the pin, which is forced out of the thimble by the expansion of the spring. The springs in the fixture are then brought into continuous contact by the pressure of the pin, the circuit is thereby closed, and the alarm transmitted to a central station, where measures can immediately be adopted for extinguishing the fire. The device is applicable to open or closed circuit, and to all purposes for which a thermostat is required. It is an efficient substitute for the more complicated and expensive thermostats, and should be very reliable, as the wires and connections are constantly being tested.

AN IMPROVED ELECTRIC SYSTEM.

THE Sperry system of electric lighting, which has been widely introduced, especially in the Western States, has recently been considerably improved. The dynamo as now made is shown in

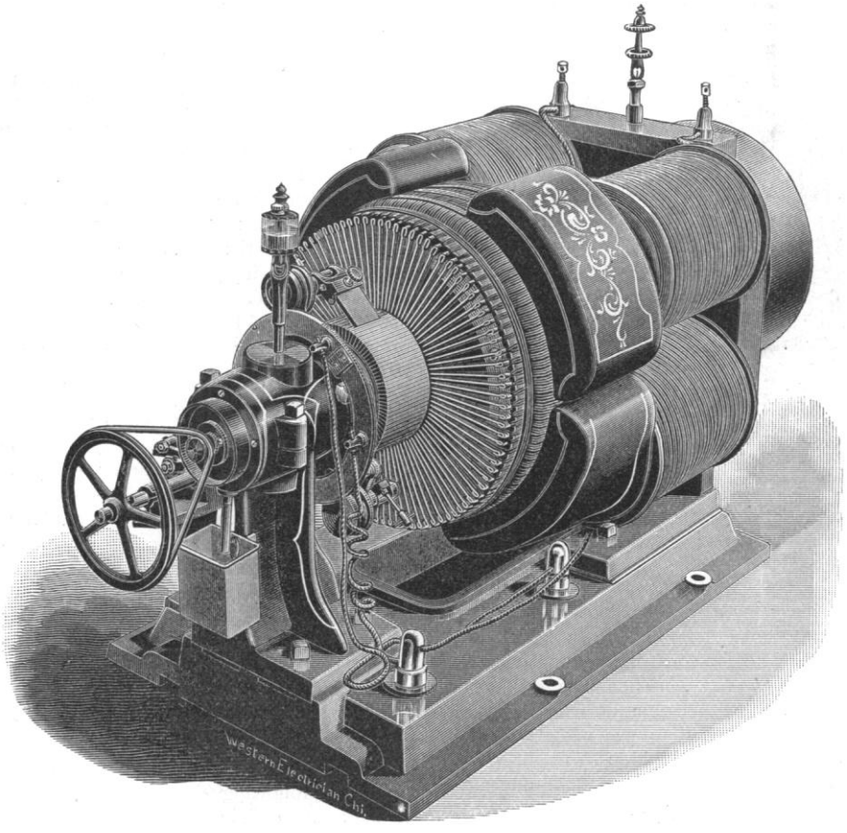
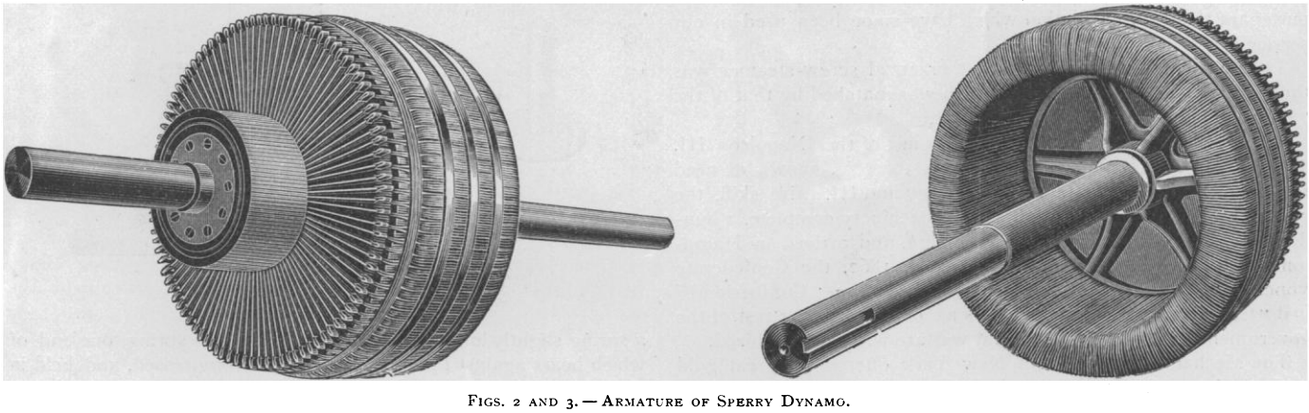


FIG. 1. — SPERRY DYNAMO COMPLETE.

Fig. 1. A special feature of this is the automatic regulator. The brushes consist of overlapping flat copper strips attached to a movable yoke. This yoke is connected by means of an arm to an electro-magnetic regulator placed in the lamp-circuit. Any variation in the electrical resistance of the lamp-circuit operates the keeper of the electro-magnet. By an ingenious device, this movement adjusts the current of the dynamo in proportion to any variation in the resistance of the lamp-circuit. The manufacturer claims that all of the lights, a single light, or any number from zero to full capacity, may be extinguished without danger to the dynamo, and without the presence or knowledge of the dynamo-tender or engineer.



FIGS. 2 AND 3. — ARMATURE OF SPERRY DYNAMO.

The field-magnets (Fig. 4) are provided with an annular recess, in which the annular armature (Figs. 2 and 3) rotates. It is claimed that by employing this peculiar construction of the armature, and

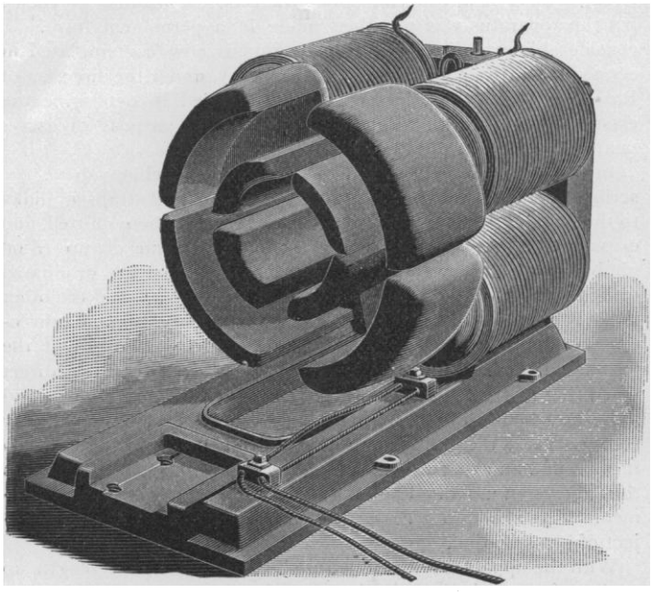


FIG. 4 -- FIELD-MAGNETS, SPERRY DYNAMO.

exposing its inner surface to the action of the inner pole-pieces, the output of electrical energy is increased.

Another feature of the Sperry armature is that there is no overlapping of coils, each coil being separate and distinct from the

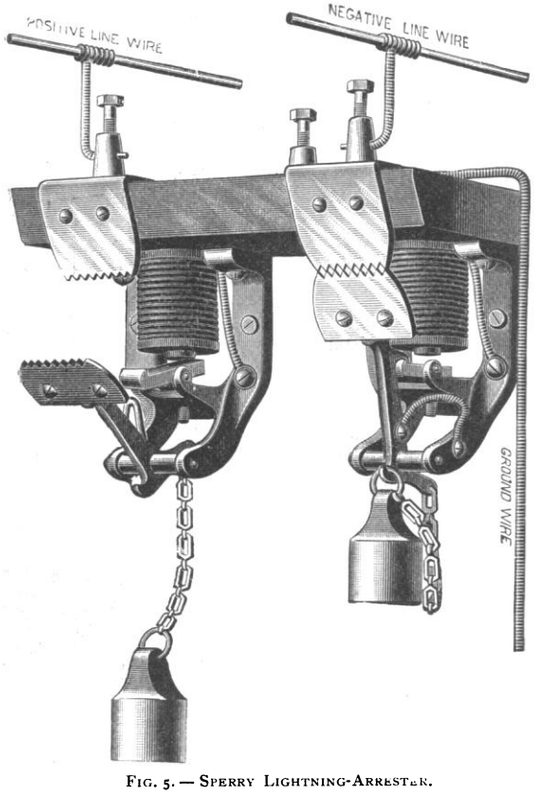


FIG. 5. — SPERRY LIGHTNING-ARRESTER.

others. Thus any mechanical injury sustained by one coil will not cause the destruction of the whole armature, as the injured part can easily be removed, and replaced by a new one, without disturbing any other coil.

Each lamp is provided with a hand-switch, and also an automatic switch, which cuts the lamp out of circuit in the event of neglect or carelessness on the part of the trimmer, or trouble in the lamp itself. The regulation is such that the carbon rod is made to operate in both directions, up and down, without friction. On starting the machine, the normal arc is at once secured, and maintained throughout the entire operation.

The discharge-plates of the lightning-arrester are movable, one from the other, in such a way as to break the arc established between these two plates, which follows the discharge of static electricity from the line, be it produced by lightning or friction electricity by belts, which has been discovered to be the case in some instances. The arc being ruptured automatically, and the plates restored, no

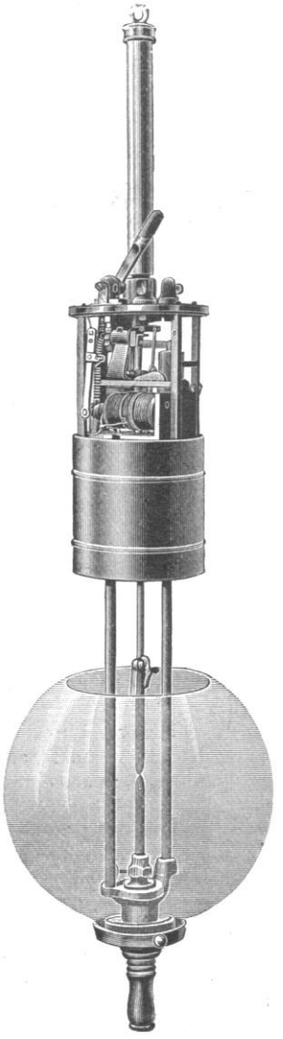


FIG. 6. — SPERRY ARC-LAMP, TOP REMOVED.

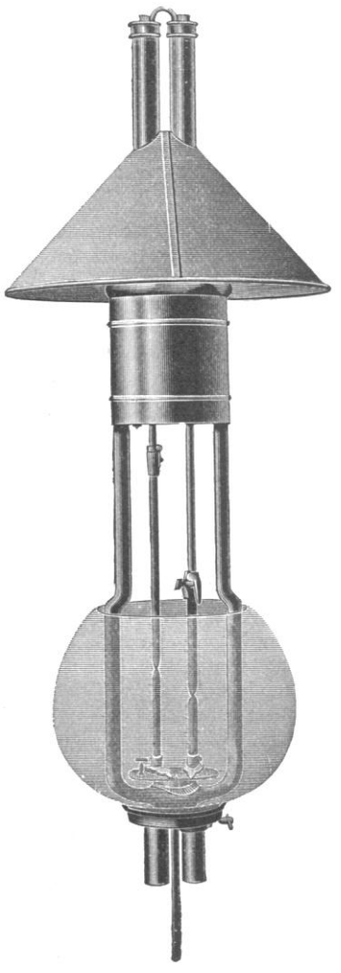


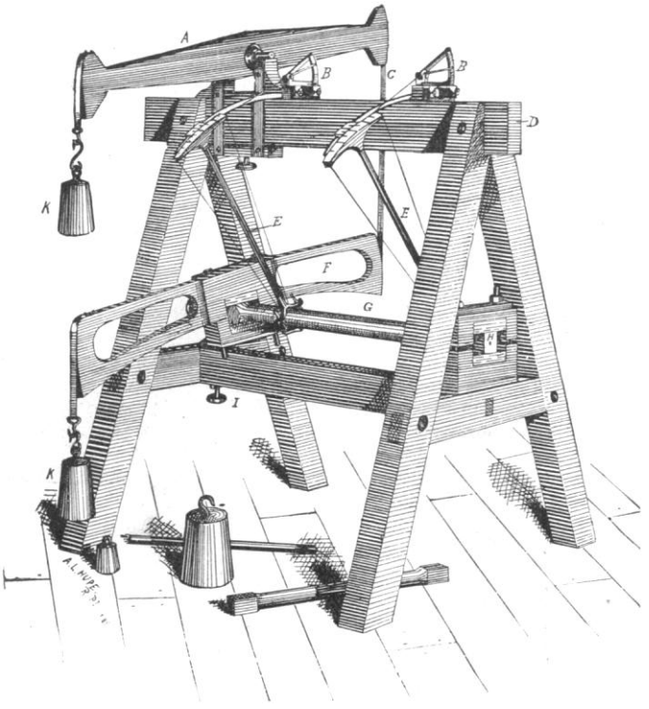
FIG. 7. — LAMP COMPLETE.

shutting-down of the light is necessary; and the consumer knows nothing of its operation, and is not annoyed by the extinguishing of his light. All possibility of disabling the dynamo from lightning is done away with, either from lightning direct or from the instantaneous short-circuiting of the dynamo, resulting from the arc established between the two leads by way of the two discharge-plates, which are present in all forms of lightning-arresters. These lightning-arresters have operated continuously for over two years upon sixty and eighty light circuits. Heavy discharges have been taken off of lines continuously all last summer and spring, and the apparatus has not been injured in the least. A single lightning-arrester serves for an entire circuit, being attached to both positive and negative wires between the dynamo and first lamps on either lead, the ground wire being attached to the rear terminal or binding-post, all of which are shown in Fig. 5.

GRAY'S TORSIONAL TESTING-MACHINE.

THE accompanying figure illustrates an apparatus recently designed by Professor Thomas Gray of the Rose Polytechnic Institute, Terre Haute, Ind., for the purpose of testing the torsional rigidity of different kinds of materials.

The figure has been prepared from a photograph of a rough and



GRAY'S TORSIONAL TESTING-MACHINE.

inexpensive form of the machine, which was somewhat hurriedly made in the workshops of the institute by students, for use in the engineering laboratory course of the current year.

The apparatus, as here shown, consists of a wooden trestle, on the top bar, D, of which there is mounted a cross-beam A, about four feet in length, which rests, through knife-edges at its centre, on a support which can be clamped at any point of the bar D. The ends of this beam are cut to circles having the knife-edges as centre; and to one end a thin steel trap, C, is fixed, the lower end of which is attached to a cross-beam, F, of the same length as A. The beam F is clamped to one end of the specimen, G, which is being tested by means of strong clamps, which take different forms, and are made of different materials, according to the form and nature of the specimen. The other end is held in a similar clamp at H, and this clamp is firmly fixed to the trestle.

The end of the specimen to which the beam F is attached is kept in position by means of an attachment similar to the tail-stock of a lathe, the clamping-screw for which is shown at I.

This centre-bearing also prevents any cross-bending force being applied to the specimen by the weight of F. The torque, or twisting-couple, is applied to the specimen by hanging weights, K, K, on the free ends of the beams A and F. These weights should be of equal amount, as they then produce a pure twisting-couple without applying any force to the centre-bearing.

The amount of distortion produced by any torque applied to the specimen is measured by means of two indices E, E, which are clamped to the specimen at a measured distance apart. The outer ends of these indices carry a graduated arc, on which the angular displacement can be read by means of a fixed mark or vernier. For specimens of such large diameter that the limit of elasticity is exceeded before a sufficiently large deflection can be given to the indices E, E to render this method sensitive enough, the deflection is indicated by a multiplying index, B. An important feature of this apparatus is the elimination of any uncertainty as to effect of the clamps by measuring the relative twist at two sections a short distance from the ends.

This same method was adopted some years ago by Professor Gray, in a series of experiments on the elastic constants of rocks, but the apparatus was not then made in a permanent form. A considerable extension of the experiments is now contemplated in connection with investigations in seismology, under the direction of Professor Mendenhall, in which it is intended to determine the elastic constants of a number of rocks, for the purpose of ascertaining the theoretical velocity of a seismic wave.

In the more complete design of the testing-machine above described, both ends of the beam A are connected by straps or links to the beam F. The tail-stock centre-bearing is then omitted, and cross-bending stresses are avoided by mounting the clamp H on gimbals, which allow freedom to transverse motion. A graduated disk is then substituted for one of the indices E, E; and the other index is carried on a bar which extends from the clamp, in a direction parallel to the axis of the specimen, up to the front of the graduated disk. The relative distortion is thus read off direct when that method is sufficiently sensitive, or by means of a second index attached to the disk when higher sensibility is desirable. For some purposes the gimbals are mounted on a worm-wheel, which turns round an axis parallel to the direction of the specimen, which thus allows an unlimited amount of twist to be given to the specimen. This becomes necessary when torsional strength is the object of investigation.

With the apparatus here illustrated, specimens of any length up to three feet can be included between the clamps; while specimens of any length can be tested in sections of three feet or less, the ends being simply allowed to project beyond the clamps, and the tail-stock bearing modified to a V instead of a centre-bearing. As regards the power of this machine, it is capable of testing a three-inch steel shaft up to its limit of elasticity.

THE MACRÆON SECONDARY BATTERY.

THERE is no field in which experiment is being more actively prosecuted than in that of the storage of electrical energy. From the experience which has been gained in the last five or six years, the failings of secondary batteries have become pretty well understood, and many inventors are trying to remedy them. The two types of battery which have been at all generally used are the Faure and the Planté. In the former a support-plate is provided, and some salt of lead is mechanically applied to it, which forms the active material. In the latter the active material is obtained from the support-plate by reversing the current passing between two lead plates in dilute sulphuric acid. The Faure cells take but a very short time to manufacture: the Planté type takes several

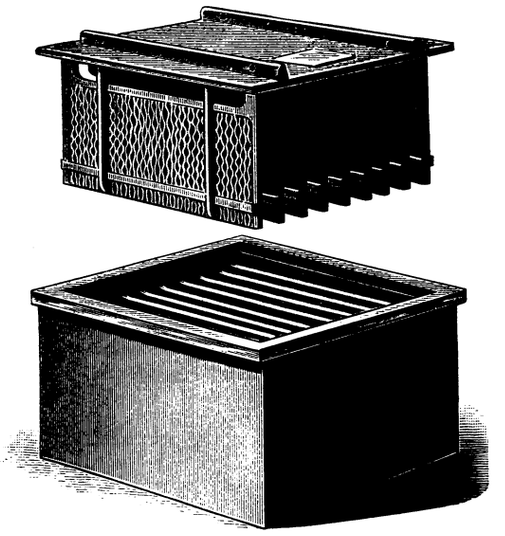


FIG. 1. — THE MACRÆON STORAGE-BATTERY.

months. The advantages of the Faure type are the ease of manufacture, and the capacity, which is greater than that of the Planté type. The disadvantages are in the rapid depreciation and the limited discharge-rate.

In the Macræon battery the attempt is made to take advantage of the good points, avoiding the troubles. This is done in the following way. The negative plate is made according to the Faure process, as distinguished from the Planté. A framework of lead is filled in with active material obtained by fusion. The cross-bars making up the frame are thinner than the finished plate, so nothing but the active material is exposed to the liquid. The negative plates are permanently connected to the metallic box, which takes the place of the glass or rubber boxes now generally used.

The positive plates are made according to the Planté plan: the active material is obtained from the support itself by the chemical action of the current. But instead of the forming process taking months to accomplish, as in the original Planté process, it is accomplished in a few hours, the result of the special electrolyte used in the Macræon battery. The form of the positive plate is also an important question. In this cell it is made of corrugated strips of

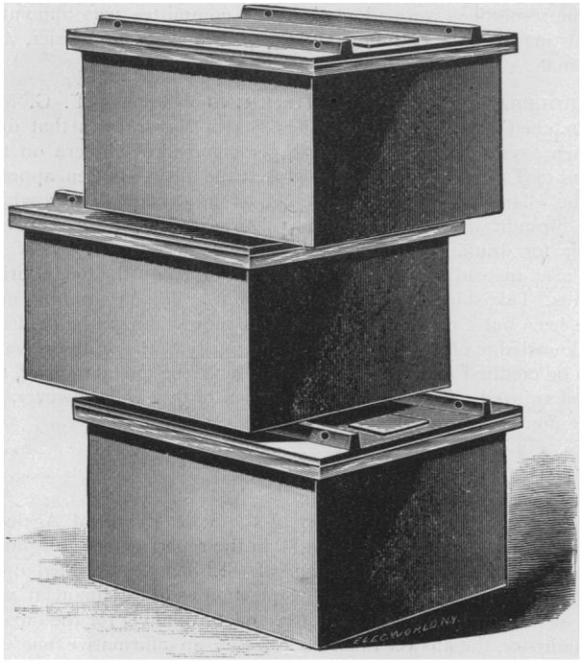


FIG. 2. — THE MACRÆON STORAGE-BATTERY.

lead, fastened at the top to the crossbar of a lead frame, while at the bottom they have a freedom of movement which prevents "buckling" when the strips expand on discharge. These positive plates are fixed to the metallic top of the box. When the cover is in place, the top of the cell is positive, and the bottom is negative, with an insulation between them. The closing of the cell avoids the occurrence of acid fumes, and the evaporation of the acid.

The following tables give some data as to the performance of the cells: —

Stationary or "Central Station" Type.

Size.	Normal Charging Current.	Normal Discharge Current.	External Dimensions.			Weight Complete in Pounds.	Normal Capacity in Ampère Hours.
			Length.	*Width.*	*Height.*		
A	6	1–8	11	5¾	4½	35	50
B	12	1–17	11	5¾	6½	52	100
C	20	1–32	10½	10	6½	80	200

Portable Type for Railroad Purposes.

Size.	Normal Charging Current.	Normal Discharge Current.	External Dimensions.			Weight Complete in Pounds.	Normal Capacity in Ampère Hours.
			Length.	*Width.*	*Height.*		
D	20	1–25	11	5¾	6½	48	200
E	30	1–50	10½	10	6½	78	350
F	1–2	1–3	3	4	6½	–	8–9
G							
H							

ELECTRICAL NEWS.

The Velocity of Light.

ACCORDING to the electro-magnetic theory of light, which recent investigations, mathematical and physical, have rendered so probable, the velocity of light is equal to the quantity v, the ratio of the electro-static and electro-magnetic units of electro-motive force. Sir William Thomson has been engaged for some time on a series of measuring-instruments which will, by electro-static force, measure potentials from 40 to 50,000 volts. The method of calibration allows a determination of v to be made. The easiest way to get known potentials up to 200 or 300 volts is by sending a measured current through a known resistance, the difference of potential at the terminals of the latter being CR, the product of two easily measured quantities. This is the plan Sir William adopts for the calibration of instruments giving the lower readings, and the accuracy is within at least one-twentieth per cent. By the aid of condensers, these potentials are multiplied up to 2,000 or 3,000 with an accuracy of one-fifth per cent; and, by the aid of an intermediary electrometer, this is raised to 10,000 volts, with about the same limit of accuracy. This last measure, based on the original electro-magnetic determination with the resistance and current may now be compared with the electro-static measurement of the same potential made by an electro-static balance. Sir William has not been able to make sure of the accuracy of this last instrument to within more than one-half per cent, but within this limit the comparison of the two methods gives a ratio within one-half per cent of 300,000 kilometres per second. The velocity of light is known to be within one-fourth per cent of this value, — a most satisfactory agreement, speaking well for the accuracy of the new instruments.

The series of ammeters that Sir William lately developed will be of great practical benefit to electricians; their great range, accuracy, and permanence making them almost invaluable for certain classes of work. The series of volt-meters on which he is working will be of equal value, and we look forward to the time when they will have passed through the experimental stage.

ABSOLUTE RESISTANCE OF MERCURY. — In a recent number of *Wiedemann's Annalen*, F. Kohlrausch publishes a redetermination, which he has carried out with elaborate precautions, of the absolute resistance of mercury. The method employed was Weber's method of the damping of a magnet in a coil, with some slight modification of Dorn. The result arrived at is, that the resistance of a cubic centimetre of mercury at 0°C. is 94,060 centimetre seconds. In order to compare this with the B.A. unit, Mr. Glazebrook has compared one of the author's mercury standards with the B.A. unit in the Cavendish Laboratory, and finds, that, according to Kohlrausch's determination, one B.A. is equal to 0.9866 of an ohm. This would give a length of between 106.2 and 106.3 for the column of mercury of one square centimetre in section, having a resistance of one ohm.

ELECTRIC LOCOMOTIVES FOR MINES. — In this country the only applications of electricity to traction in mining, with which we are acquainted, is in Lykens, Penn. In this, current is conveyed to

the motors through an overhead wire. In Europe there are several successful examples of electric tramways in mines, and lately Messrs. Immisch & Co. have built a new mine-locomotive from the designs of Mr. Reckenzaun. Storage-cells are employed for supplying current, and a single motor of four-horse power. The gearing is peculiar. On the armature-spindle is a small phosphor-bronze pinion. This gears into four steel pinions placed in the same plane, and 90° distant from each other. These pinions are bushed with gun-metal, and run on steel pins carried on a cast-iron disk. The disk revolves on a journal turned outside of the end of the motor-bearing. Outside of, but in the same plane with, these pinions, is fixed an annular casting of gun-metal, with teeth cut on the inside. The steel pinions gear into the ring, which forms a fulcrum, on which they revolve when the motor-spindle turns. The power is transmitted from the cast-iron disk by a sprocket-pinion keyed to it on the inside next to the motor, and a steel chain connects this sprocket-pinion to a suitable wheel mounted on one of the axles, while the other axle is connected to this by coupling-rods. The storage-battery consists of forty-four modified Tatham cells, each box being 10 inches by $6\frac{1}{2}$ inches, by 11 inches high. The boxes are lead-lined, and arranged in sections of three in wooden trays. Each box contains nineteen plates 7 inches by $4\frac{1}{4}$ inches, by $\frac{7}{32}$ of an inch thick, and has a capacity of 150 ampère hours, the weight being 53 pounds. The rate of discharge varies from 25 to 50 ampères, and sometimes, on starting, this increases to 65 ampères. Taking 40 ampères as the average rate, the weight of these cells for a discharge equivalent to one horse-power is nearly 500 pounds, and per horse-power-hour storage-capacity, 134 pounds. The Messrs. Immisch are now working on some improvements by which the capacity will be increased. This locomotive, on a grade of 1 in 70, would just move, with a load of twenty loaded cars equivalent to eleven tons. With fifteen cars, weighing eight tons and a half, the speed was three miles per hour, the current being 45 ampères at 100 volts pressure. On a grade of 1 in 40 the maximum load was eight cars, and on 1 in 25 it was six cars, the speed being a little over two miles an hour. On the level the locomotive could draw thirty cars, the current employed being 45 ampères.

FELLING TREES BY ELECTRICITY. — Hitherto machines for felling trees have been driven by steam-power, but this is sometimes inconvenient, especially in thick woods; and now the London *Times* reports that electric power has recently been adopted in the Galician forests. Usually in such machines the trunk is sawed, but in this case it is drilled. When the wood is of a soft nature, the drill has a sweeping motion, and cuts into the trunk by means of cutting edges on its sides. The drill is actuated by an electric motor mounted on a carriage, which is brought up close to the tree and shackled to it. The motor is capable of turning round its vertical axis; and the drill is geared to it in such a manner that it can turn through an arc of a circle and make a sweeping cut into the trunk. The first cut made, the drill is advanced a few inches, and another section of the wood removed in the same way, until the trunk is half severed. It is then clamped to keep the cut from closing, and the operation continued until it would be unsafe to go on. The remainder is finished by a hand-saw or an axe. The current is conveyed to the motor by insulated leads brought through the forest from a generator placed in some convenient site.

HEALTH MATTERS.

Public Inspection of Food.

THE following resolutions were offered by Dr. George Strawbridge at a recent meeting of the Philadelphia County Medical Society: —

"The Philadelphia County Medical Society begs to call the earnest attention of city councils and the Legislature of Pennsylvania to the pressing need of provision for the inspection of all meat and milk used as food, with a view of furnishing sound meat and milk to the people.

"The society would also urge the necessity of killing and destroying all animals afflicted with tuberculosis, and the owner should be indemnified by the State.

"The society also recommends that a committee of five be appointed by the president of the society, whose duty it shall be to represent the society with a view of obtaining further information, and to confer with other bodies acting in this matter."

Dr. Strawbridge, in introducing his resolutions, said: "Statistics as reliable as can be obtained make the statement not too broad, that in Philadelphia, about the present time, there is from three to three and one-half per cent of tuberculosed meat used, and from six to eight per cent of tuberculosed milk. Here in Philadelphia to-day there is no inspection of any kind. The best the board of health could do was to obtain an appropriation of fifteen hundred dollars for the appointment of a milk-inspector, who will probably start to the stations to see how much water goes into the milk. Anybody can dump any kind of food in Philadelphia, and we must take it; but if we refuse to eat it, we are told that we are not good citizens. Meat ought to be inspected when alive, and also during the process of slaughtering. Unless you can inspect the animal alive, and also when the internal parts can be viewed, the inspection is useless. In the inspection of milk, the principal thing is to see the cows that give it, so that they are not diseased, and to inspect it at its place of delivery."

The resolutions were adopted, and a committee was appointed consisting of Drs. Leffman, Huidekoper, Shakespeare, Osler, and Cleeman.

CHOLERA CONTAGION IN DRINKING-WATER. — F. G. McKean, chief engineer in the United States Navy, states that during ten days in 1885, nine hundred persons died of cholera on the island of Takashima in Japan, and that the disease often appears on the island. Suspicion was drawn to the drinking-water, which was brought from the mainland. During 1888 the use of this water for drinking-purposes was abandoned, and distilled water was used instead. Although cholera prevailed on the neighboring islands, Takashima was entirely exempt. This exemption may have been but a coincidence; still, it is more than probable, from our knowledge of this disease, that the purity of the drinking-water is to be credited with the immunity which the population of the island enjoyed. To be absolutely certain of this, will, however, require more continued observation.

NOTES AND NEWS.

IN the "Sixth Biennial Report of the State Board of Agriculture of Kansas," Mr. E. B. Cowgill, in the report on the sorghum-sugar industry, says: "The season of 1888 has been looked upon as the one which should settle the question as to the financial success of the sorghum-sugar industry, and, fortunately for the incoming industry, the answer must be taken as an affirmative one. It is true that not all of the factories in Kansas are able to show balances of profit. The fact, however, that the favorable results obtained in 1887 at Fort Scott have been more than repeated at that place in 1888; that a factory at Topeka has demonstrated the practicability of the sugar industry at that place; and the further fact that Conway Springs and Douglass, in the face of adverse circumstances, have shown the industry to be independent of all patented processes and machinery, — will go far toward assuring all diligent inquirers of the success of the Northern sugar industry. Indeed, upon the most careful study of the subject, I have no hesitation in saying that the sorghum-sugar industry is now on such a footing as to invite the investment of capital, where such investment is placed under good business management, efficient, practical skill, and competent, scientific direction."

— A recent invention of Messrs. Randall & Carter, for the preservation of freestone from the effects of weather, was exhibited by them at the Cannon Street Hotel, London, on Feb. 15, in the presence of a large number of architects and builders. Several specimens of well-known oolitic freestones, which had been treated by this process in such a manner as to make their surfaces quite hard enough to be polished, were shown. The process consists of treating the stone with a compound of milk of lime, acetic acid, and cane-sugar (or molasses), which, when applied, soaks into it for a depth of about half an inch, and produces a slight chemical change, materially hardening it. The stone may either be entirely im-

mersed in this solution, or the latter may be applied to its surface with a brush. The surface is then rubbed to a face with fine grit, and allowed to dry, after which it is subjected to a diffused dry heat of from 130° to 160° F. in an oven. When the stone to be treated is fixed in position, as in a building, it is stated that the compound may be applied with a brush, either with or without heat subsequently. Although it is admitted that by heating the stone its durability is greatly increased, the London *Builder* thinks it questionable whether this is practicable on a large scale after it is built up. But even supposing it were practicable, it is very doubtful whether the hardened surface would protect the stone for any great length of time. Experience has shown, that, where only a hardened coating has been formed, moisture soaks in, either through the cracks in the masonry or through portions of the surface of the stone itself, rendered vulnerable by the defective application of the preparation, whatever it may consist of. The moisture collects behind the hard coating, and produces a line of weakness, in consequence of which the thin crust flakes off. Moreover, it is wrong to suppose, that, because a lime solution hardens a stone, the latter thoroughly resists decay, as has often been suggested. The mere fact of the stone being hardened does not add much to its durability from a chemical point of view, unless the hardening material be acid-resisting. The only effect of the hardening is to render the stone less absorbent, and therefore slightly more durable, for a few years at most.

— Lord Wolseley, who is not often caught tripping in making hasty statements, writes as follows in the current number of the *Fortnightly Review*: "The battles of the future will be very different from even those of 1870. . . . One remarkable change will be the absence of nearly all that terrific noise which the discharge of five or six hundred field-guns, and the roar of musketry, caused in all great battles. . . . The sound of cannon will be slight, and will no longer indicate to distant troops where their comrades are engaged, or the point to which they should consequently march. Our sentries and advanced posts can no longer alarm the main body upon the approach of the enemy by the discharge of their rifles. The camp or bivouac will no longer be disturbed at night by the spluttering fire of picquets in contact with the enemy. Different arrangements for giving the alarm upon the approach of hostile columns will have to be resorted to. The main column on the march cannot in future be warned, by the shots of flanking parties, of the enemy's proximity, and a battle might possibly be raging within a few miles of it without that fact becoming at once apparent." *Nature* asks that some competent member of the "Scientific Corps" will kindly explain.

— The prefect of police in Paris has issued a new set of regulations with regard to the fire brigade service in theatres, which will, it is thought, reduce very much the risk of fire; so far, at least, as it can be reduced in the many theatres in Paris which have always been, and must remain, from the position they occupy, regular death-traps. A certain number of firemen are allotted to each theatre, who, under no pretence, are to be called out of the theatre, or to receive visits from friends or acquaintances. The chief of the detachment has the responsibility of seeing that all the apparatus for extinguishing a fire is in its allotted place and in proper order, and the commissary of police is to satisfy himself that this has been done before the theatre opens. During the representation the chief of the detachment must be constantly moving about to see that the men are at their posts, that no one is smoking in the corridors or carrying open lights, and that access to the reservoirs and fire-plugs is not hampered by placing any scenery or stage properties in the way. He is to examine the manometer, and, if he finds that there is a deficiency of pressure in the water-mains, he must inform the nearest post of the fact. In the event of an insignificant outbreak, recourse is to be had only to the apparatus within reach of the *foyer*; but, if the outbreak is of a more serious character, the nearest post is to be informed by telegraph. At the close of each representation the firemen are to make a round of the theatre, and see that the iron curtain is lowered, the buckets filled, and the folding doors closed, and, in the event of these not working smoothly, they must be repaired at once. The manager of the theatre is required implicitly to obey the orders of the district commissary of police, who, in the event of an outbreak of fire, assumes the sole command of the theatre until the arrival of the prefect of police or the chief officer of the fire brigade.

— *Nature* makes the following extract from a letter addressed by Mr. A. W. Tuer to a contemporary: "The melodious hum of skating was perhaps never heard to greater advantage than through the crisp air of a bitterly cold morning little more than a fortnight ago, — the first Sunday in the year. Almost as soon as Kensington Gardens were entered, one became conscious of a clearly defined musical sound coming from the direction of the Round Pond, — G as nearly as I could judge, but corrected to G sharp, when, half an hour later, I got to a piano. I had wished to compare the notes — probably lower — given forth by other and larger sheets of ice, but procrastination strangled an opportunity which perhaps others will take when it again offers. Comparing a sheet of ice to a taut string, and the countless skates to the hairs of a bow, — scientifically, a poor comparison enough, — the sound might be expected to have been like that produced by the scraping of a fiddle, but it exactly resembled the whistle of a distant locomotive."

— The following description of some of the most important features of the subsurface torpedo-boat lately submitted to the Navy Department by the Columbian Iron Works of Baltimore, and the uses for which it is intended, serve to clear up several points which might possibly have caused a misunderstanding as to the nature of the craft. The boat is cigar-shaped, and is capable of being operated under three different conditions: first, above the surface, that is, with nearly half of it above water; second, awash, that is, with only a few inches of the back exposed, together with the conning tower; third, completely submerged, that is, with nothing whatever appearing above the surface. In the last condition, which is the primary condition for torpedo warfare, the boat's means of offence is a horizontal tube directly in its axis, from which are discharged 8-inch projectiles either by pneumatic power or by powder. These projectiles are capable of giving several hundred feet range, and the gun and projectile are constructed on a principle first propounded by Lieut.-Commander Barber at the United States torpedo-station in 1873, but separately invented, and proved successful by Mr. Holland, the inventor of this boat. In lieu of this submarine gun, the boat will be fitted with any kind of locomotive torpedo that the Navy Department may desire to be fired from this or a similar tube. In addition to this tube in the axis of the boat, there is another 8-inch tube, fitted at an angle, for over-water fire at distances of 1,000 yards or thereabout. It is intended to use this tube for throwing dynamite shells, under circumstances where the boat cannot approach the enemy within torpedo range, or where it may be preferable not to try to do so. The boat has a double skin on the upper forward part, separated by about a foot of space; and this space is filled with water, which flows freely into it. Abaft of this, and forward of the gun-room, is a vertical bulkhead of several inches of iron. When, therefore, she is lying awash, and using her upper pneumatic gun (which makes no smoke), she will be almost invisible to the enemy, and, if struck by machine-gun projectiles, she is almost certain to be uninjured.

— The wine-making industry in California is the subject of an interesting article by Edwards Roberts in the supplement to *Harper's Weekly* of March 9. The article is copiously illustrated.

— The Eiffel Tower has already attained a height of 280 metres, and in a month it will be completed by the turret and the electric lantern, which will give it its greatest height of 300 metres. The Paris correspondent of the London *Builder* says, "It is curious to notice to-day how inferior is the effect produced by this enormous piece of iron-work to the idea that people had of it in advance. Seen from the environs of Paris, it overpowers the city, and appears immense by the side of the large monuments, which are reduced to very small dimensions; but the nearer one approaches it, the less is one aware of its colossal proportions, and the eye hardly sees what relation can exist between the thin termination of the tower and the gigantic arches of its base. There is an optical illusion about it which will always weaken its general effect, and disappoint the hopes of the promoters of this useless attempt to astonish the eye by its giddy height."

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CONTENTS:

JOHN ERICSSON was a man with the best of brain-power, with confidence in himself, who lived at a time when the world was ripe for what he could best do. He was essentially a great mechanical engineer. And not only was he fortunate in the age in which he lived, but he was wise in his choice of a place of residence. The fate of mechanical inventions is like that of the seed in the parable: the invention must fall on a proper soil, and be nurtured by favorable circumstances of time and place, in order to bloom into success. Thus Ericsson was early led from his home in Sweden to England, where he found a congenial environment till the conservatism of the English Admiralty drove him to this country. He was a man accustomed to carry through to useful perfection any scheme which commended itself to his mind; and, having confidence in himself, he found criticism difficult to endure. He knew he was right in his propeller for steam-vessels, and quickly left the country which refused to adopt it for America, where within two years the new device was in use on forty-two vessels. He knew he was right in his "Monitor," and was mortified and indignant at the hesitation of the American naval board in giving him a contract for building the first of this class of war-vessels. His work in each of these cases was not simply the devising of a form of propelling apparatus which would be better than the old side-wheel, or of a form of ironclad which was the best there was at the time; but every mechanical detail of the "Princeton" and of the "Monitor" received some improvement at his hands.

Such was the man, and such was his work. He had the perseverance, the capacity to appreciate the importance of details, and the confidence in himself, which lead to success. And what was his reward? Doubtless he received considerable payments for much of what he did; but in the case of the "Princeton" it is said the government is still his debtor, and in that of the "Monitor" he received only the amount due him on his contract. As an inventor who supplied the government with an all-important engine of war, he received not a cent. Nor would he listen to the suggestion frequently urged on him by congressmen and others, that Congress should be asked to recognize his claim, and to provide for it. The Legislature of New York passed a resolution, thanking him for his services to the country, which he insisted on freely giving; and these resolutions he highly prized. Ericsson is said not to have cared for money, and this would certainly seem to be true.

The respect shown at his funeral was such as is seldom seen at that of any private citizen. The streets in the neighborhood of his late residence were crowded from the early morning hours with thousands, who for four hours passed through the house to pay homage to the departed genius. New York is a place full of human beings, — so full that each pays little or no heed to his neighbor; yet the great respect for this man of science and of action was shown in the number and character of those who followed his remains to their resting-place, in the uncovered heads as they were borne along the busy streets, and in the impossibility of admitting to Trinity all that wished. Ericsson was a man who could have endeared many to him, but he had a strong sense of duty to his work, which induced him to make few friends. This final homage of the unmindful crowds of the great city was to his genius well applied.

PUBLIC HEALTH A PUBLIC DUTY.

THE address of President Charles N. Hewitt, at the sixteenth annual meeting of the American Public Health Association, was full of suggestion, and contained many valuable propositions. It was entitled "Public Health a Public Duty," and dealt with the organization, powers, and relations of local, State, and National boards of health. In reviewing the work of the association, and the progress made in sanitary science during recent years, he said: —

"As secretary of one of the oldest of the State boards [Minnesota], I had the honor of an election as an original member of this body, and have known its history since. In my own State, beside, I have been missionary at large, and served as the organizer and counsellor of many a local board, and as sanitary inspector and health-officer as well. I have seen our organizations grow from two feeble boards with ill-defined powers, in 1872, to over fourteen hundred, united under a common code of law, with largely increased powers, duties, and funds. There is not to-day in Minnesota a community, however small, without such a board in direct communication with the State board.

"The State boards of health have increased from three in 1873, to thirty-one in 1888. Largely through their efforts, popular knowledge and confidence have grown from the tentative methods of the past to the demand for, and more liberal support of, sanitary organization and positive work. More and better legislation, great sanitary engineering works, and a bountiful crop of private enterprises in the same direction, are among the evidences that our field is widening and our responsibilities increasing. We have seen the early examples of efficient State executive organization become a living force in many more of the States and Canada. Various departments of modern science are our willing helpers. Microbiology has opened up great stores of discovery, and awakened great hopes, which we trust may not fail. We have seen the be-

ginnings of international co-operation for the crushing-out of cholera, yellow-fever, and other epidemics, which must in the near future become a beneficent reality, taking its place with arbitration, in international disputes, as the most valuable victories in our century.

"The first essential of any sanitary authority," Dr. Hewitt says, "is executive power, and its systematic use in the regular and scrupulous performance of every-day duty, as defined in the law and suggested by every-day experience. This almost self-evident proposition is constantly neglected in legislation for organization, and is very frequently violated by boards of health, who seem to favor the popular idea that an exceptional occasion is necessary to the highest exercise of their power, and infectious diseases of the classical type are their selection, with a proper admixture of panic. Panic is no advantage any longer, if it ever was, as a help to sanitary organization and work. Infectious diseases are not the leading causes of our sickness and mortality. It is only in the exceptional severity of plagues like yellow-fever, as it has prevailed in Florida, for example, that infectious disease counts the most victims in the sickness or death roll. That epidemics prevail at all, in our time and country, is somebody's fault: for, if there is one thing more than another that modern hygiene ought to be able to do, it is to forefend their attack, or control them if they effect a lodgement; and boards of health and health-officers have to learn that the most public and pronounced activity, after the invasion of infectious disease, is no substitute for the quiet, unobtrusive work which, in daily faithfulness, would have detected the first case, and controlled its spread. Another pressing need is a better classification of causes of death, for sanitary purposes, to which should be added causes of sickness and of permanent ill health from disease. At present our professional nomenclature is as vague sometimes as the popular one. Cholera-infantum and heart-disease are little more accurate than 'too weak to live,' a common popular cause of death under one year. The general divisions of the English registrar-general's tables are the best known, but some of the subdivisions are not satisfactory. Isolation has become so important and efficient an aid in the control of many diseases, that it is time to devise some changes in our customary methods which shall insure more thoroughness, with the least interference with the liberty of the family. It is a serious matter to restrain the bread-winning power of a laboring man or of his self-supporting children; and it is a still more serious matter to shut up a suspected family, sick and well, in a small house, when the removal of perhaps a single patient might save the rest, or some of them. The isolation home, under various names, is the ideal method of us all; but, if we had one always available, people must be educated to its use. We need it most for diphtheria and scarlatina. Another essential is an apparatus, not too expensive or elaborate, or too heavy for easy movement on wheels, for disinfecting clothing, bedding, and the like, by steam. One to which steam could be supplied by the boiler of a thresher-engine would serve our country districts, and the same could be used where steam-boilers are available elsewhere. It could be taken to the infected house, charged, closed, and moved to the nearest available boiler, connected, disinfected, and discharged of its contents, with no danger, and at trifling expense. Still another need in this connection is a ready way of disinfecting the sick-room while occupied. Its essential feature should be the removal of the infected air and dust, disinfecting both as they escape, and the introduction of fresh air, so that quantity, temperature, moisture, and movement may be as required by the sick, but all to be done with the most complete protection of the well. The means must be easy, comparatively inexpensive, and available in the average houses of the laboring population. The stove, stove-pipe, or chimney, affords the available means in such houses in cold weather. In warm weather the open fire, gas, or kerosene, might serve to provide the means for exhausting the foul air and introducing that of the open in its place. Add to the simplest form of apparatus (the open fire or stove-pipe exhaust), cleanliness, fresh air, sunlight, thorough inunction, and boiling water for infected clothing of the sick and attendants, and you have a method almost everywhere practicable, which will reduce the danger from such diseases to the minimum, and the mortality as well.

"The very large mortality from non-infectious disease, under five years of age, is, in the light of our present knowledge, no longer tolerable; and boards of health should move now, and positively, for its material reduction. By the last census this mortality was 43.7 per 1,000 of living population for the whole country, while in thirty-one registration cities it was 88.4 per 1,000. The mortality under five years to total of all ages was given as 39.8. The deaths under one year were, for the whole population, 120.9 in 1,000 living, while for the cities it was 267.5. This does not tell the whole story, as the statistics are estimated to fall from 15 to 30 per cent below the facts. We have no means of accurately estimating the sickness rate which accompanies this mortality, but may assume that it is enormous.

"Another subject of increasing importance, and which ought to receive the immediate attention of the State boards, is the sanitary relation of certain diseases of animals as communicable to man, notably tuberculosis, trichinosis, and glanders; and the increasing possibility that diphtheria and scarlatina may belong to the same class. The relations of the diseases of the cow to the influence of milk as food are attracting wide-spread attention, and, as affecting a very important infant food, deserve an attentive study with reference to sanitary control. On this subject, popular and certain professional opinion has, as usual, gone to extremes. From the use and even advocacy of distillery-milk, some have come to refuse the purest supply except after boiling, and their foolishness has been an acceptable and pecuniary advantage to the manufacturers of the proposed 'substitutes for cow's milk' which fill our markets and are tried on our children. The importance of the subject has resulted in making the control of infectious diseases of domestic animals one of the duties of the State and local boards of health, as in Minnesota, where the experiment has proven eminently successful and satisfactory.

"For the Nation and the States, the most urgent lesson is organization and efficient co-operation: for this last experience [of the epidemic of yellow-fever in Florida] but adds another to the accumulated evidence of the near past, that no State or province on this continent can afford to be any longer without a board of health officered by experienced men, who have the confidence of the people and governments they serve; supplied with unquestioned legal authority and sufficient money; and provided with every recognized means for dealing directly, and to the best advantage, with any disease of men or domestic animals threatening, or actually invading, the State. It must also, and for the same reason, have authority and funds to act with similar authorities of other States, in mutual co-operation, for State and national defence. It will not do to forget the established fact, that epidemics are now to be looked upon as evidences of the failure of public health, in organization or administration. That they occur, or spread, is presumptive evidence, when properly qualified authorities exist, that they neglected to take the needed measures, or were unable to take them. I see no escape from this conclusion, except it be shown, in any case, that prevention or control was beyond the resources of our art.

"A central State authority, organized and equipped as proposed, will find itself unable to do efficient preventive or restrictive work without thoroughly organized local sanitary authorities in every township, village, and city; and, further, each local board should have the same powers, and proportionate means, as the State board, in the locality it serves. Enforcing the common law, and independent in all purely local administration, the local authorities should be a unit for common purposes, under the State board, of which the control of infectious diseases is a conceded example.

"There are now in the United States thirty-one State boards of health. The first was organized in 1869, and others as well, before any attempt at national organization was made. Some of these boards are fully equipped with legal powers and funds for the work we have found laid out for them. The rest, with varying degrees of speed, are coming on to the higher level necessary for efficiency, and all are growing in usefulness and experience.

"State boards of health are established and recognized forces to-day; and any national organization attempted must, to be successful, be a development from them in form and function, for the purpose of carrying over to the nation, as a whole, the sanitary succor which the best of the State boards afford to the populations

they serve. A national board of health must first supply the national need proven to exist, by the conjoined efforts of the efficiently organized State boards, and fill up the full measure of that work within the national boundaries. So established, in the same dignified relation to the National Government that such State boards bear to the governments of the several States, it is prepared to perform the twofold duty, beyond our borders, which results from our present knowledge of the modes of approach and attack of infectious diseases. It must protect the nation, first, by a thorough knowledge of the character, location, and movements of such diseases abroad; second, by preventing, by the best-known methods, the shipping to this country of infected persons, animals, or things; third, by insisting upon competent sanitary service on board ship, with the best facilities for preventing, controlling, and crushing out any form of infection discovered on the passage out; fourth, by providing that the sanitary authority at the port of entry shall be fully informed of what is known of the sanitary history of the ship and her lading, up to the date of arrival, with later telegraphic report from the American consul and health-officer at the port of departure, if necessary.

"It is a fact that to-day, if it will, our government may learn all that is here proposed, by locating competent health-officers at the foreign shipping ports, whence our greatest danger comes, and might keep the seaboard quarantine authorities fully posted in these important particulars. As to those local authorities, it is time to call a halt in the criticism of their work till all sides in the controversy can be heard; or, better still, till health-officers of inland States can visit and see for themselves. Until the State boards agree in organization and powers, and in proper relations to local boards, the re-organization of the National Health Service upon a sufficient and permanent basis will be difficult, if not impossible."

THE RESOURCES OF THE NYASSA REGION, EAST COAST OF AFRICA.

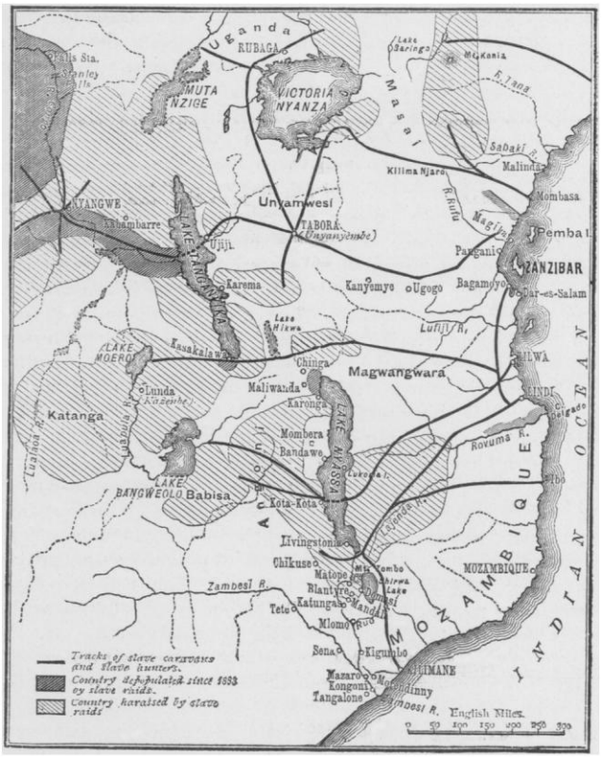
FOR a number of years two English companies have been carrying on a profitable trade in the Nyassa and Tanganyika region, which, however, has recently suffered a severe check by the uprising of the Arabs against European influence. In a recent number of the *Journal of the Manchester Geographical Society*, Messrs. James Stevenson and E. O'Neill, consul of this district, give some interesting reports on the state of affairs and on the resources of this country, from which, and from some observations of other travellers, we take the following notes. Mr. Stevenson's paper is accompanied by an interesting sketch-map, reproduced here, showing the extent of the ravages of the slave-trade and the caravan routes in this region. The map will be of interest as supplementing the general map of Africa showing the extent of the slave-trade, published in *Science* of Dec. 28, 1888.

The produce of the Nyassa region, and the methods of trading, are well described by Mr. O'Neill. First in importance among the objects of trade is ivory. To this most valuable of all exports, — putting aside for the present any possible supply of minerals, — trade must chiefly look for an immediate return on its capital. Perhaps there are no better elephant-hunting fields in Central Africa than the great marshes of the Shire River and on the west coast of Lake Nyassa. The supply from these might be largely increased, to the benefit of trade, the country, and the people generally. The Arab slave-dealer is the chief collector of ivory in this country, with the tusks of which he loads his slaves, obtaining thereby cheap and profitable carriage to the coast. The British trader upon the Nyassa obtains but a fraction of the whole amount collected, — just so much as the Arab chooses to part with to enable himself to renew his supply of barter-goods, and to resume his collection in the interior. While the operations of the British trader on the Nyassa are confined to his station on the shores of the lake, he plays the dignified *rôle* of a storekeeper to Arab traders, where they may renew their store, and be relieved of a journey to the coast.

Much has been said of the check given to the slave-trade by the taking-up of the ivory on the Nyassa from the hands of the Arab collector, thus obviating the necessity for slave-carriage to the coast. But it is certain that a very slight blow is struck by this means at the slave-trade. Little good will really be effected until the collection in the interior is also carried out by the whites, and the Arab trader is undersold, and thus peacefully ousted from the collecting-field. The British trader has every advantage on his side. Water-carriage should place his goods upon the Nyassa cheaper than they can be carried there overland by the Arabs, who have also to contend with the high percentage exacted from them for advances by the Indian trader of Zanzibar or Mozambique.

Next in importance to ivory must be placed India-rubber, in which the country west of Nyassa, stretching towards Lake Bangweolo, is undeniably rich; but comparatively little is collected, as the natives know little of the value of the plant, and have never been taught to collect it. Its export might probably be indefinitely increased by the same means which would help to extend the ivory-trade.

There are many other products indigenous to the country, but few of those known are able to bear the present cost of carriage to



the markets. When the country comes to be better known, the number of more valuable products will be undoubtedly increased. Consul O'Neill says in regard to this point: "How completely valuable products may remain hidden until some chance brings them to light, I can instance by the case of *Strophantus Kombe*, of which some specimens were sent by me to the Foreign Office in 1881. A demand for it as a drug for heart-disease shortly after sprung up, and, its existence in this country having been thus proved, I was able to start its collection in the Shire and Nyassa districts and in the Gaza country. The first consignment home proved to be so valuable to the collectors, that soon a rush was made to collect it, and the natives were quickly taught to bring down the pods in large loads. In the same manner we may hope other valuable products will come to light, and more profitable exports found than the oil-seeds which now form the staple articles of production on the coast and the lower Zambezi and Shire Rivers."

To estimate justly the probable development of this region, it must be remembered how slow and gradual has been the development of trade on the African coast. When the British Indian traders, to whom, a little more than a century ago, the Portuguese viceroy of India granted a monopoly of the trade of East Africa, arrived on

the coast, trade was precisely in the condition we find it now in the interior. The natives knew nothing of the collection of valuable products, — knew not, indeed, of their existence until shown. Now, on the coast, and for a hundred and two hundred miles inland, they have learned the demands of trade, and a regular collection is made by them of rubber, calumba, orchilla, and copal.

So far, we have spoken only of the export of produce indigenous to the country. When Europeans, however, begin to settle in it, — and in a small way this settlement has already begun, — fresh sources of wealth are opened up; and other products, for which the climate and soil are found favorable, are cultivated, and their export forms a valuable adjunct to that of the natural products of the country. Coffee and sugar have already been raised with success; and wheat, tea, and cinchona are are all undergoing trial. The coffee and sugar consumed at the mission-stations are mostly home or Nyassa grown, and very good in flavor and strength. Recently Angora goats have been introduced for the production of mohair.

The climate of this region, which is from three thousand to five thousand feet above sea-level, is considered comparatively healthy, and, although it is not probable that it will ever become the home of a numerous white population, is well adapted to the establishment of plantations, worked by natives and managed by whites. The lake itself, which is only sixteen hundred feet above sea-level, has not as favorable a climate as have the slopes of the highlands.

The most important feature of the Nyassa region is its easy access. The uplands surrounding the Nyassa are divided by the only navigable waterway to the coast of Africa, and this alone marks it out as one of the first districts of East Central Africa for European occupation. There is nothing like it farther south, where European settlers are steadily advancing. To be able to step into a river-steamer at a seaport, as may be done now at the mouth of the Zambezi, and be carried up in five or six days to the foot of the Shire highlands, within a day's walk of the first settlements, is an immense step already gained. The new river-steamer plying on the Shire and Zambezi is a stern-wheeler, intended to carry seventy-five tons on a moderate draught. There is also a steamer of considerable size in course of construction on Lake Nyassa.

The trading company of Lake Nyassa, and the missions of that region, — the Free Church of Scotland Missions, which occupy the west coast of the lake; the Universities' Mission, which occupies the east coast of the lake, — have expended altogether some $750,000 on this region. In pursuance of these objects, a survey was made of a road for about forty-six miles through the rough country of Lake Nyassa, towards Lake Tanganyika, which is reached from the terminal point of that road through an easy country. The road was made by native labor, and the traffic on it was at first worked by parties hired by the company from the Nkonde, Wanda, and Mambwe tribes, with all of whom the company made treaties by which its authority was recognized over these districts. At present its management has, however, slipped into the hands of the Arabs, who purchase goods at the Nyassa terminus, and convey them by their own people, often slaves, to Lake Tanganyika, the European staff being too limited in numbers to superintend all the stations required.

The steady advance of commerce in this region is seriously threatened by the progress of the Arabs, who have recently also invaded this country. For ninety miles along the south coast of Lake Tanganyika almost the whole population has been swept away or scattered, and in the adjoining fertile country of Ufipa the Arabs are now in great force.

During the last year, letters from the mission-stations expressed apprehensions, on account of the presence near Lake Nyassa of an Arab trader who had formerly made slave-raids in the Tanganyika region. These traders have congregated in numbers at the Nyassa end of the road, on account of the small steamer of the African Lakes Company having been for some time detained on account of disturbances. At various points besides the north end of the lake, the Arab invaders are ready, and have added to their old station at Kota-Kota one near Bandawe Mission; and besides Losewa and Makanjiva's, they have been aggressive near Blantyre.

All reports make it an undoubted fact that the question of commercial progress in Central Africa will solely depend upon the outcome of the present struggle between Arabs and Europeans. The raids of the former are extending continually westward; and, wherever they have invaded a country, nothing but ruin remains. It appears doubtful whether the joint action of the European nations will succeed in breaking the power of the Arabs in the inaccessible fastnesses of Central Africa. It seems that the only means of success would be an absolute stoppage of the introduction of fire-arms, which would deprive the Arabs of a great part of their superiority over the native states.

BOOK-REVIEWS.

Occasional Addresses on Educational Subjects. By S. S. LAURIE. Cambridge, Eng., University Pr. 12°. (New York, Macmillan, $1.25.)

PROFESSOR LAURIE, well known as lecturer on educational history and methods in the University of Edinburgh, here gives us another volume on his favorite themes. In it he touches on a great variety of educational topics, and handles most of them with ability as well as enthusiasm. Professor Laurie believes in the importance of studying educational theories and methods, and holds that no teacher is properly equipped for his work who has not been through a course of such study; and he gives excellent arguments and illustrations in support of this view. In regard to both subjects of study and methods of teaching, he is at issue with some enthusiasts of the present day, and especially with the advocates of manual training and competitive examinations. With respect to the latter, he takes the ground that competition in school is in its nature an evil, since it fosters "the desire to beat others, and exalt self over others," which he justly affirms to be anti-social. Moreover, he maintains that educational competition does not secure the best service to society. The whole lecture on this subject ought to be carefully read by American educators. He is opposed to free schools, and presents the well-worn arguments against them, but without adding any thing new.

With regard to subjects of study, Professor Laurie is a strong advocate of the humanities. He believes in technical schools in their proper place, but speaks slightingly of manual training in ordinary schools, remarking, that, "if the spirit of man can be educated through his fingers, it is a pity that Plato and Shakspeare ever wrote, and Christ ever taught." The end of education, in his view, is not to make good workmen, but good men; and his school curriculum is arranged accordingly. He would abandon Greek as a required study, because of the importance of French and German, and would base the course of study in secondary schools on English and Latin. He has a strong and, we think, sound sense of the educational importance of literature, especially in its moral and æsthetic aspects; and he would also devote considerable time to national history and politics. Of the physical sciences he would teach only geography, which seems a very narrow view; though it must be added that he would have geography taught in a very wide and liberal spirit. In mathematics he would teach only the elementary branches; and in French and German, as much as there is time for. This programme is sure to provoke criticism, from the scientists at least; but Professor Laurie is evidently not averse to controversy. His whole book is very suggestive, and we trust will not be overlooked by any one interested in education.

A Treatise on Hydraulics. By MANSFIELD MERRIMAN. New York, Wiley. 8°. $3.50.

THIS volume is intended mainly for the use of students in technical schools, and consequently the subject has been treated, and the material selected and arranged, with a view to meet the requirements of such students. The author, who is professor of civil engineering in Lehigh University, is gifted with a perspicuous and pleasing style, and has produced a book which will without doubt prove an acceptable text-book upon the subject. A brief interesting chapter is devoted to the units of measure, physical properties of water, atmospheric pressure, gravity, and computations. A few hints on methods of study, appended to this chapter, would be of service to students in any department of science. Then follow in regular order chapters on hydrostatics, theoretical hydraulics, and the flow of water through orifices, over weirs and in

tubes, pipes, canals, and rivers. The measurement of water-power, the dynamic pressure of flowing water, hydraulic motors, and naval hydro-mechanics are treated in separate chapters, the latter subjects being given less space than their importance would seem to warrant. The book is amply illustrated.

A General Formula for the Uniform Flow of Water in Rivers and other Channels. By E. GANGUILLET and W. R. KUTTER. Tr., with additions, by Rudolph Hering and John C. Trautwine, Jun. New York, Wiley; London, E. and F. N. Spon. 8°. $4.

TO all engaged in the study of hydraulic problems, as well as to engineers who deal with the flow of water, this book will be of great service. It is the first published translation of the authors' chief work on the subject; though unauthorized translations from articles in German periodicals on this subject, by the same authors, were published in London several years ago. The first part of the work is devoted mainly to historical matter, and to a review of present knowledge of the laws governing the flow of water. A treatise on the new formula, showing its close agreement with a large number of experimental results obtained under differing conditions, makes up the second part. A supplement contains a more direct method of deriving the formula, for the benefit of those who desire mathematical brevity. A second general formula is also sketched, though not made prominent, as the first one is considered preferable.

The translators call attention to the fact that the authors have been erroneously regarded as holding their formula to be scientifically perfect, and covering both possible and impossible conditions of flow. They disclaim for them any such intention, insisting, that, as the formula is purely and essentially empirical, it must not be expected to apply to cases beyond the range of the data from which it has been derived. Its application is limited to cases where the slope of the water-surface can be ascertained with a degree of accuracy sufficient for the given case.

Nine appendices and five tables for practical use, which form part of the volume, contain much additional matter of value to those interested in the subject. In Appendices I. to IV. are given extracts from the works of Mr. Kutter upon the formula. Appendix V. contains directions for constructing the diagram used for a graphical solution of the formula. Appendix VI. is devoted to Kutter's modification of Bazin's general formula, useful for special purposes because of its simplicity. In Appendix VII. are given a number of formulæ and data concerning the relation between the mean and surface velocities in streams; the views of a number of investigators on velocities beyond which a scouring of the bed takes place in channels formed of different materials, are given in Appendix VIII.; and an account of Harlacher's method of ascertaining the discharge of rivers, in Appendix IX.

In Table I. are collected the hydraulic elements of over 1,200 gaugings, made in 300 different channels and pipes, under varying conditions of mean hydraulic depth and slope. In the original work the corresponding table is confined to 81 gaugings; so that this table is virtually the work of the translators, who believe it to be the most complete and comprehensive one yet published. The other tables contain the computed values of different elements of the formula, and the conversion of units of measure. An immense amount of labor has been bestowed upon this work by translators as well as authors.

AMONG THE PUBLISHERS.

THE delay in the publication of Sir Monier Williams's book on Buddhism has been caused by difficulties which have arisen in connection with the illustrations. A certain number of copies will be in Mr. Murray's hands at once. The work will be published in America by Macmillan & Co.

— Lee & Shepard have in press Samuel Adams Drake's "Decisive Events in American History, Burgoyne's Invasion of 1777, with an Outline Sketch of the American Invasion of Canada, 1775-76." It will be an admirable historic narrative, intended to be used as a text-book, or as a supplementary reader in schools, as well as for general reading. A valuable book, arranged especially for young people, yet by no means unsuited to any time of life, entitled "Every-Day Business: Notes on its Practical Details," by M. S. Emery, will be published soon by this house. It gives careful instruction regarding many matters closely connected with business transactions. The book will be a valuable companion for young people, and its pages will contain instructions on business subjects, being designed for ready reference, and also as a text-book for use in schools.

— Macmillan & Co. will publish shortly "Natural Inheritance," by Francis Galton; a second series of Sir John Lubbock's "Pleasures of Life;" and A. R. Wallace's work on Darwinism.

— Harper & Brothers will publish this month the second volume of W. P. Frith's "Autobiography and Reminiscences," and a new and revised edition of the "Manual of Historical Literature," by President C. K. Adams of Cornell.

— Wolcott & West, Syracuse, N.Y., will shortly publish "Theories of Knowledge," by Rev. W. D. Wilson, D.D., Professor Emeritus in Cornell University.

— D. C. Heath & Co. have just ready, in their series of Guides for Science Teaching, "Hints for Teachers of Physiology," by Dr. Henry P. Bowditch of the Harvard Medical School. It will show how a teacher may supplement his text-book instruction by simple observations and by experiments on living bodies or on organic material.

— Dodd, Mead, & Co. have in preparation the letters and diaries of Emin Pacha, which, besides containing matter of interest as biography, relate largely to the author's scientific investigations. The volume has for an introduction a biographical sketch of Emin, with two portraits, one of them recent. They have also in press Bayard Tuckerman's biography of Lafayette, to be issued in two volumes.

— T. Y. Crowell & Co., in connection with the announcement of a cheaper cloth and a paper edition of Tolstoï's great work, "Anna Karénina," translated by Nathan Haskell Dole, state that Mr. Dole's translations have been received with great favor by the Tolstoï family. In a recent letter to Mr. Dole, the Countess Tatiana Lyovna Tolstoï says, "My father has read your translations, and is much pleased with them. They are to his mind very carefully and accurately done."

— Ulric Blickensderfer, Chicago, Ill., has just issued "Blackstone's Elements of Law, etc.," with analytical charts, tables, and legal definitions, arranged and displayed by a systematic and attractive method. Mr. Blickensderfer is an attorney-at-law, and claims that these charts will be found time-saving helps to his colleagues. Sample copies may be had on application. He also has published a chart of the "Historical and Genealogical Descent of the Crown of England," which by an ingenious arrangement of types brings the history of England on one side of a sheet of paper six inches wide and eighteen inches long, which folds up like an ordinary legal document. The succession covers from A.D. 827 to the ascent of Queen Victoria in 1837.

— The article on "Climbing Mount St. Elias," to appear in *Scribner's* for April, is the work of an American member of the Alpine Club, Mr. William Williams, who, with two English fellow-members, succeeded, during the summer of 1888, in reaching the highest point ever attained on that mountain, — about 11,400 feet. Charles Francis Adams, president of the Union Pacific, will contribute a railroad article to the number, on the "Prevention of Strikes." He proposes a plan which, if carried out, would be almost a revolution in the relations of railroad employers and employees. William H. Rideing, who made a careful inspection of the great Clyde ship-yards during the past summer, will give a description of them, showing the various stages in "The Building of an Ocean Greyhound."

— Ticknor & Co.'s March books include "Dragon's Teeth," translated from the Portuguese of Eça de Queiros, by Mrs. Mary J. Serrano; and in their Paper Series, "Forced Acquaintances" (No. 53), by Edith Robinson, and "Under Green Apple Boughs" (No. 54), by Helen Campbell.

— An important undertaking is promised by the Leonard Scott Publication Company, in the American edition of the *Nineteenth Century* for March, in the shape of an American supplement containing a series of papers by some of the foremost of our educators on the relation of examinations to education. This subject has attracted considerable attention in England of late, having been started by the "Signed Protest" in the November *Nineteenth Century*. The present papers, presenting the subject from an American standpoint, will be by ex-President McCosh of Princeton, Presidents Adams of Cornell, Angell of the University of Michigan, Carter of Williams, Eaton of Marietta, Gilman of Johns Hopkins, Magill of Swarthmore, Pepper of Colby, Rhoades of Bryn Mawr, and Sharpless of Haverford; Chancellors John Hall of the University of the City of New York, and Sims of Syracuse; Professors Cook of the University of California, Harper of Yale, Harris of Concord, Hunt of Princeton, Rogers of Haverford, and David Swing of Chicago; Rev. Dr. Crosby, Hamilton W. Mabie, Esq., and Barr Ferree, Esq., of New York. Dr. William H. Burnham will also contribute, and Professor Thompson of the University of Pennsylvania. The symposium promises to form a most important contribution to the discussion of a very difficult question of educational methods. The March number of the *Nineteenth Century*, in addition to the papers on education and examination in the American supplement, will contain an article by Mrs. Humphry Ward, the author of "Robert Elsmere," on the new reformation as viewed from her own standpoint. Professor Huxley writes on "The Value of a Witness to the Miraculous;" and the review contains criticisms on his paper on agnosticism in the February number, by the Rev. Dr. Wall, principal of King's College, and Dr. Hagee, bishop of Peterborough.

— The *Popular Science Monthly* for April will contain a scientific explanation of the power to insnare the human mind possessed by the leading delusion of the present day. The article is by Professor Joseph Jastrow, and is entitled "The Psychology of Spiritualism." It contains accounts of the manifestations by the Fox sisters, Dr. Slade, Englinton, and other mediums, all of which have been proved to be "gross intentional fraud throughout." Professor Huxley has written a racy reply to certain criticisms of agnosticism made at the Church Congress of 1888, and to a recent deliverance by Frederic Harrison, who attempts to prophesy on this subject. The article contains an account of how the name "agnostic" originated, and explains why agnosticism, as Professor Huxley conceives it, cannot have a creed. It will also be published in the April *Popular Science Monthly*, as will an article on "The Chemical Elements," by Professor Josiah P. Cooke of Harvard, telling the story of the changing beliefs about what substances are made of, from the time when earth, water, air, and fire were thought to be the elements of all things, down to the present day, with its list of over seventy simple substances, and when the idea is gaining ground that perhaps there is only one kind of matter, after all.

— The paper in the *Political Science Quarterly* for March that will attract most attention is that by Mr. H. O. Arnold-Foster, on "Irish Secession." It gives what is probably the best presentation of the Unionist argument that has appeared in this country, and should be carefully read by every one desirous of understanding the question at issue. The author takes up the home-rule arguments one by one, and gives a conclusive answer to some, at least, of them; while at the same time he presents very forcible considerations to show that an Irish parliament is equally undesirable for England and for Ireland. Another article of interest is that by A. Gauvain, on "The Crisis in France." M. Gauvain is deeply impressed with the low character of French political life, with the feebleness of the senate and the fickleness of the Chamber of Deputies, and with the instability of the administration; and he evidently views the future with some alarm. He affirms, as other observers have done, that there is no statesman of ability in the country, and that the republicans are drifting towards radicalism. Meanwhile the monarchists are gathering strength, and, with the aid of the Boulangists, stand a good chance of carrying the coming elections. The *Quarterly* has still another article on foreign affairs, that by Professor Gustav Cohn, on "Income and Property Taxes in Switzerland." Injustice has often been done in all countries to the poorer classes by raising too large a portion of the national revenue by indirect taxation; and Professor Cohn here shows how the Swiss have endeavored to remedy this by laying a large share of the burden on property and income. Mr. H. L. Osgood has a paper on "Scientific Anarchism," in which he traces back the doctrine to Proudhon as its real originator, and then shows what changes it has undergone at the hands of the "Individualistic Anarchists" and the "Internationals," concluding with a brief but decisive argument against the whole scheme. Besides the various essays, the *Quarterly* has an extended review of Bryce's "American Commonwealth," by Professor Woodrow Wilson.

— Houghton, Mifflin, & Co. have just issued a new life-size portrait of Dr. Holmes, which is even better than the earlier one.

— Charles Scribner's Sons have in preparation a handsome popular library edition, in four 12mo volumes, of Bourrienne's well-known "Memoirs of Napoleon," a standard work of which many hundreds of imported sets have been sold every year. This new edition will be an exact reprint of the latest English edition, and will contain the thirty-eight portraits of the original, together with all the other features that give distinction to the work. The price will be sufficiently low to bring these volumes within reach of all would-be readers.

— G. P. Putnam's Sons have in press, as their own commemoration of the centennial anniversary of the inauguration of Washington, a unique limited edition of Irving's "Life of Washington," — a work for which Bryant predicted "a deathless renown." The set will be issued in five volumes, handsomely printed in large quarto form, and will contain 200 illustrations, comprising 130 steel plates and 70 woodcuts printed on India paper and inlaid in the text. The plates include portraits of all the noteworthy generals and statesmen of the American Revolution. But 300 sets will be issued, and the type will be distributed as printed from. The price to subscribers has been fixed at $50.

— Mrs. Stowe has been able to revise the biography of herself, written by the Rev. Charles Stowe and Mr. Kirk Munroe. It will be published at an early day by Houghton, Mifflin, & Co.

— Baron Grancy will shortly issue, in Paris, a volume on American customs. It is to be in the shape of a novel, to be entitled "A French Ranch in Dakota," and will treat wholly of Dakotan affairs. The author, according to a despatch to the New York *World*, is the original founder of the Fleur de Lys settlement of French horse-breeders, whose life in Dakota this book is meant to describe.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

Twenty copies of the number containing his communication will be furnished free to any correspodent on request.

An Acoustic Mill.

WHEN a vibrating tuning-fork is brought near to a light body, like a pith-ball or a small piece of paper, the latter moves towards the fork as if attracted by it. This phenomenon was observed by Guyot in 1832, and was rediscovered by Guthrie in 1870. It has been supposed by some that gravitation could be explained by the vibratory motions, such as atoms and molecules are known to have; but it does not appear that gravitation sustains any quantitative relation whatever to the temperature of a body, such as would be the case if molecular vibration was the cause of it. The observed phenomenon may be accounted for thus. When the prong of the tuning-fork beats outwards, the air is driven before it and is condensed, while behind it there is a partial vacuum. If the velocity of the prong was greater than that of a particle of air in its free path movement, then there would be a complete vacuum behind the prong. As the latter beats to and fro, it is obvious that the density of the air adjacent to the prong must be less than if the latter was at rest, the difference depending upon the relative velocity of the prong to that of the molecules of air in their free path movements. As the pressure of the air varies as its density, it follows that the air-pressure is less in the neighborhood of the vibrating fork than at a distance from it. Hence, if an object is near to the vibrating fork, the air-pressure will be greater on the remote side, and will push the object towards the source of vibrations.

Numerous devices have been invented by Doornak and Strop to illustrate this principle. Most of them are too complicated and costly to be had by more than a few. The following is simple enough, and can be available for any one having a Chladni plate.

Cut a disk three or four inches in diameter out of letter-paper, and then cut eight or ten radial slits from the circumference halfway to the centre, and turn up one edge of each sector so as to form a kind of paper windmill. Suspend this by a thread from its centre, and see that it hangs horizontally, which may be done by fixing a bit of beeswax to the middle of the disk, and have the thread go through it. Adjustment will be easy and quick by slight pressure upon the wax, changing the relative position of the thread.

This disk may now be brought over a properly mounted Chladni plate near the edge, and as close to it as possible, while allowing it free space for rotation without touching the plate. If the plate be made to vibrate vigorously, the disk will begin to spin, turning in the same direction as if a current of air were blowing upon it from above. The lower components of the sound of the plate will be necessary to make so large a disk as the above to spin, as the higher ones have too many nodes. The fundamental is the best; and, if it can be produced with an amplitude of an eighth of an inch or more, the disk will go round two or three times a second. Of course, the bow should be drawn across the edge opposite to the disk, in order to prevent a node being formed underneath it, and also to avoid the disturbance from movements of the air. I have found that the fundamental vibration of the Chladni plate can more easily be produced by bowing it with a round wooden rod well rosined, than with the ordinary violin-bow. In this experiment the pressure of the air is lessened between the nodes at the surface of the disk, and the space thus affected extends to the height of an inch or two. It is also evident that the light dust that moves to the place of greatest disturbance is moved there by the difference in air-pressure instead of by little whirlwinds caused by the vibrations, as it was explained by Faraday.

A. E. DOLBEAR.

College Hill, Mass., March 5.

Note on the Robinson Anemometer Constant.

THIS is the factor by which the velocity of the central point of the cups is reduced to the actual velocity of wind. When Dr. Robinson first invented his anemometer in 1860, he determined the value of this factor, for all patterns of the instrument, to be exactly 3, and this has been in use for all patterns ever since. But by the experiments of Dr. Dohrandt at St. Petersburg in 1878, this constant, for the Kew pattern at least, was found to be much less, which led Dr. Robinson to repeat his experiments; and the result was a confirmation of Dr. Dohrandt's result, and showed that his own factor is erroneous. Experiments at the Deutsche Seewarte in Hamburg have also given a factor much smaller.

The labor of the wind-force committee of the Royal Meteorological Society, referred to in my previous note (*Science*, xiii. p. 171), has been directed mostly toward determining this factor for several anemometers of different patterns, which are as follows: —

	Arms.	Diam. of Cups.
	Inches.	*Inches.*
Kew Standard	24.00	9.0
A 19	5.80	4.0
A 21	6.75	2.5

These were placed near the end of a long arm of a whirling apparatus, moved by a small steam-engine with varying velocities. The number of turns of the anemometer compared with that of the whirling apparatus during any given time of uniform velocity, the relations between the length of the arm of the anemometer and the distance on the arm from the centre of whirling being known, gave the ratio between the velocities, and so the value of the constant, which is found to be about the same for all, except very small, velocities.

The average of 58 experiments with the Kew Standard gives 2.15 instead of 3 for the value of this constant. From 51 experiments made with A 19, the value 2.51 was obtained, while the average of 49 experiments with A 21 gave 2.96, which is very nearly that determined by Dr. Robinson, and now in use. It is seen, therefore, that while the Robinson factor is very erroneous for the Kew pattern, and also for A 19, but especially the former, it is very nearly

correct for A 21. The use of the factor 3 for all patterns of anemometers now for nearly thirty years has introduced a great amount of error in published wind velocities; so that they are not only not comparable generally with one another, but the errors have likewise affected most, if not all, the results obtained from the discussions of these velocities. It is much to be regretted, therefore, that some standard pattern had not been adopted and its constant accurately determined at the start, instead of deferring it for nearly thirty years; for, if this is even now done, it will be a long time before any adopted standard and its true constant can come into general use.

Since the force of the wind is as the square of the velocity, errors in the estimated velocity of the wind give rise to errors in the pressure of the wind which are proportionately more than twice as great. For instance: if the true velocity of the wind is 30 miles per hour, the Kew Standard with its factor 3 makes it 42 miles nearly, an increase in the ratio of 1 to 1.4; but the force of the wind is increased in the ratio of 30^2 to 42^2, or as 1 to 2 nearly, and so in a ratio more than double the preceding one. In estimating the force of the wind from the indications of the anemometer, the effect of the error in the factor 3 of the anemometer, and of the wind-pressure constant .005, now in general use, are both in the same direction; so that the combined errors of both are very great. For instance: in the case of a wind of 30 miles per hour, we have seen above, that the error of the factor 3 applied to the Kew Standard increases the force of the wind in the ratio of 1 to 2; and if the wind-pressure constant should be .003 instead of .005, then the effect of both errors is to increase the estimated force of the wind above the true force in the ratio of 1 to $2 \times \frac{5}{3}$, or to more than three times the real force. Of course, this is an extreme, but not an impossible case; for in anemometers mostly used the error of the factor 3 is not nearly so great as for the Kew Standard, and the true value of the wind-pressure constant may come out a little more than .003 when accurately determined, but still the errors of estimated wind forces, with the constants in use, are undoubtedly enormously large. Mr. Whipple, of the wind-force committee, says, that, "unless the Robinson anemometers could be put into the hands of those who would take care of them, their indications were frequently worse than useless. The instruments require to be continually looked after. Even if carefully attended to and regularly cleaned and well oiled, their records are far from satisfactory."

It is the opinion of the writer that they must in time give way to something better, probably to Mr. Dines' newly invented helicoid anemometer, which is more simple in its mechanical action, and, according to the experiments made with it, seems quite satisfactory. A description of this instrument is found in the *Quarterly Journal of the Royal Meteorological Society* for July, 1887.

WM. FERREL.

The Soaring of Birds.

THERE can be no doubt that the explanation of soaring given by Mr. Gilbert is mechanically sound. The only remaining question seems to be as to its sufficiency. In regard to this question, the following considerations may be of service: —

There is a certain velocity relative to the air such that a bird possessing it can be sustained against gravity without muscular exertion. Let V represent that velocity for a given bird. Let there be two horizontal layers of air, whose relative velocity is i. For simplicity, let the velocity of the lower layer be zero, that of the upper i. Suppose the bird at some instant to be in the upper layer, moving in the same direction with it, and with a velocity relative to it of V, so that he can just be sustained while moving horizontally. His velocity relative to the lower layer is $V+i$. Let him now descend into the lower layer and wheel horizontally 180 degrees. In so doing he necessarily loses some energy, and his velocity decreases. Now, in order that he may be sustained at the same level during the wheeling, his velocity relative to the lower layer must not fall below V. Suppose his decrease of velocity to be a little less than i; he will then be moving opposite to the direction of the upper current, with a velocity greater than V. He can therefore not only maintain his level, but can rise. Let him now enter the upper layer, his velocity relative to it being $V+i$. If, now, he can wheel horizontally through 180 degrees without losing more than the velocity i, he will be in a position to repeat the cycle.

The statement of Professor Oliver in *Science* (xiii. p. 16) seems to imply that the difference in velocity of the air-currents needs to be as great as the relative velocity which will enable the bird to sustain himself against gravity; that is, that i must be as great as V. If the discussion here given is correct, such is not the case. It is only necessary that the bird should have initially a sufficient relative velocity, and should be able to wheel horizontally 180 degrees without losing by "friction" enough energy to reduce his velocity as much as i, the velocity of one air-current relative to the other.

L. M. HOSKINS.

University of Wisconsin, Madison, March 5.

"Shall We Teach Geology?"

WHEN a reviewer bases critical verdicts on ignorance or misapprehension of the work reviewed, he has an advantage over the author, of which, in my own experience, I usually leave him in quiet possession. Still the meekness of silence may not always prove most useful to the public. Your reviewer of my work, "Shall We Teach Geology?" in No. 317, says that I ignore the mental and moral sciences as means of culture; but he should have observed that I do not undertake to discuss the education value of all sciences and literatures, but only of those selected as types by certain pedagogical writers who hold geology in disesteem. Your reviewer states that I mention "history only to slight it, declaring that it trains no faculty but verbal memory." My criticisms on history contemplate it as a study urged upon children in the early stages of education. This is what I have recorded on purpose to forestall such an accusation. "My present investigation concerns studies as usually taught and in schools of the lower orders. In college, history and literature are pursued in a nobler and more cultural way" (p. 148). Your reviewer employs the term "literature" in the wide sense, which makes it a much more valuable thing than literature as used in the narrow sense of the author, whose positions I am examining (note, p. 145). Your reviewer states, also, that I claim for geology that "the subject should be taken up in the primary schools, and pursued every year as long as the student attends school." This is preposterous criticism. Such is not my position, nor is the idea anywhere conveyed. I think the subject should be taken up briefly, two, three, or more times, at successive stages of mental development, not completed in one course late in school-life (see pp. 133, 134).

ALEXANDER WINCHELL.

Ann Arbor, Mich., March 5.

To keep Water-Mounts Moist.

IN my last communication on this subject (*Science*, xiii. p. 170) I recommended glass capillary tubes. I since find that a much simpler plan, and one that serves equally well in most cases, is to suspend from the edge of the cover-glass, to a beaker of water beneath, a moistened piece of filter-paper about four centimetres long and half a centimetre wide.

Likewise, in the study of germination of seeds, the capillary tubes or the moistened filter-paper may be put to good service. Very clean and satisfactory specimens of the first stages of germination may be obtained by placing the moistened seeds in contact one with another on a glass slip over a beaker of water, and suspending from their midst to the water one of the tubes or simply a narrow piece of paper. A bell-jar will exclude dust.

E. B. KNERR.

Parsons College, Fairfield, Io., March 6.

The Wind-Pressure Constant.

IN my note I see you have put Hazen for Hagen. The latter is a German physicist of Berlin. Will you please make the correction in your next number? This is important, since Hazen has also made experiments, the results of which differ very much from Hagen's, and it may seem that I have misrepresented his results.

WM. FERREL.

Kansas City, Mo., March 5.